Ballantine

# 5725A
# FREQUENCY COUNTER

BALLANTINE LABORATORIES, INC.

Ballantine

# 5725A
# FREQUENCY COUNTER

SERIALS PREFIXED 020

**WARRANTY**

*90 days free check if returned to factory prepaid providing no damage or misuse has occurred.*

*For the remainder of the first 12 months after leaving factory a $35 handling charge applies for recalibration or repair of defect not caused by misuse or mishandling.*

**BALLANTINE LABORATORIES, INC.**

P.O. BOX 97
BOONTON, NEW JERSEY 07005 USA
201-335-0900/TWX: 710-987-8380

90100171A September 1972

# TABLE OF CONTENTS


*Page*

**SECTION 1. GENERAL INFORMATION**

1-1. Introduction . . . . . 1-1
1-2. Instrument and Manual Identification . . . . . 1-2
1-3. Optional Accessories. . . . . 1-2

**SECTION 2. INSTALLATION**

2-1. Introduction . . . . . 2-1
2-2. Receiving Information . . . . . 2-1
2-3. Packing . . . . . 2-1
2-4. Power Connections . . . . . 2-2
2-5. Cooling . . . . . 2-2
2-6. Clock Selection . . . . . 2-3

**SECTION 3. OPERATION**

3-1. Introduction . . . . . 3-1
3-2. Controls, Connectors and Indicators . . . . . 3-1
3-3. Sensitivity Control Adjustment . . . . . 3-1
3-4. Operating Hints . . . . . 3-4
3-5. Operating Procedures . . . . . 3-5
3-6. Operation in COUNT Mode . . . . . 3-5
3-7. Operation in FREQ Mode . . . . . 3-6
3-8. Operation in RATIO Mode . . . . . 3-7

**SECTION 4. PRINCIPLES OF OPERATION**

4-1. Introduction . . . . . 4-1
4-2. Assembly Designations . . . . . 4-1
4-3. Front Panel Input Circuit Operation . . . . . 4-2
4-4. Time-Base Circuit Operation . . . . . 4-2
4-5. Control Circuit Operation . . . . . 4-2
4-6. Counting Circuits Operation . . . . . 4-4
4-7. Power Supply . . . . . 4-4

**SECTION 5. MAINTENANCE AND CALIBRATION**

5-1. Introduction . . . . . 5-1
5-2. Test Equipment . . . . . 5-1
5-3. Instrument Cover Removal . . . . . 5-1
5-4. Cleaning . . . . . 5-1
5-5. Visual Inspection. . . . . 5-3
5-6. Repair and Replacement . . . . . 5-3
5-7. Front Panel Input Circuit Adjustment . . . . . 5-4
5-8. Oscillator Calibration . . . . . 5-4
5-9. Troubleshooting By Self-Check . . . . . 5-6
5-10. In-Cabinet Performance Check . . . . . 5-6
5-11. Voltage Reading . . . . . 5-7

**SECTION 6. PARTS LIST**

**SECTION 7. CIRCUIT DIAGRAMS**

*Table 1-1. Specifications*

## FREQUENCY

**Input:** Via front panel BNC connector
**Frequency Range:** 5 Hz to 80 MHz
**Gate Time:** 1 msec or 1 sec
**Accuracy:** ±1 count ±time base accuracy
**Readout:** KHz or MHz with positioned decimal point

## COUNT MODE

**Input:** Via front panel BNC connector
**Frequency Range:** 5 Hz to 80 MHz
**Counter Range:** 1 to $10^5$ counts
**Gate Time:** Manually selected. When the START pushbutton is pressed, the START pushbutton is pressed, the count is initiated and continues. When the STOP pushbutton is pressed, the count stops and the display holds the number accumulated.
**Accuracy:** Absolute
**Readout:** Dimensionless

## FREQUENCY RATIO MODE

**Input (F1):** Front panel BNC connector
**Input (F2):** Rear panel BNC connector
**Measures:** F1/F2 with the FREQ switch set to MHz and (F1/F2) X $10^3$ when set to KHz
**Number of cycles of F2 averaged:** $10^3$ with the FREQ switch set to MHz and $10^6$ when set to KHz
**Readout:** Dimensionless

## INPUT CHARACTERISTICS

FRONT PANEL

**Impedance:** 1 Megohm shunted by 25pF approx.
**Input Coupling:** AC
**Frequency Range:** 5 Hz to 80 MHz
**Sensitivity:** 75 mV rms from 5 Hz to 40 MHz increasing to 120 mV rms at 80 MHz
**Maximum Input:** 250 V rms 5 Hz to 1 KHz. 10 V rms above 10 MHz. Sensitivity control provided as screwdriver adjust on front panel

REAR PANEL

**Input Requirement:** Standard TTL (nominally 1 V to 5 V p-p), DC coupled
**Frequency Range:** DC to 5 MHz

## OUTPUT CHARACTERISTICS

**Frequency:** 1 MHz (from Int. Crystal Osc.)
**Amplitude:** 5 volt approx.
**Coupling:** DC
**Output Impedance:** 1 Kohm when "low" and 1.5 Kohm when "high"

## DISPLAY CHARACTERISTICS

**Type:** 5 long-life glow discharge display tubes
**Display Storage:** Prior reading is held while new reading is being made. Time between successive measurements is 100 msec. The storage is disable in the COUNT mode.

*Table 1-1. Specifications (Continued)*

**Gate:** LED indicator, lights up when the counter gate is open
**Decimal Point:** Fixed for readings in KHz and MHz
**Overrange:** LED indicator, lights when the counter capacity is exceeded
**Manual Reset:** Front panel pushbutton switch resets the display and all registers to zero

## TIME BASE

**Crystal Frequency:** 1 MHz
**Aging Rate:** Less than 2 parts in $10^6$ per month
**Temperature Stability:** Less than 5 parts in $10^7$ per °C from 0 to 40°C

## GENERAL

**Height:** 3¼" (83mm)
**Width:** 8" (203mm)
**Depth:** 7 3/8" (188mm)
**Weight:** 3 lbs. 9 oz. (1.6 kg)
**Power Requirements:** 115 or 230 volts rms ±10%, 48 to 65 Hz, 10 watts approx.
**Temperature Range:** 0°C to 40°C

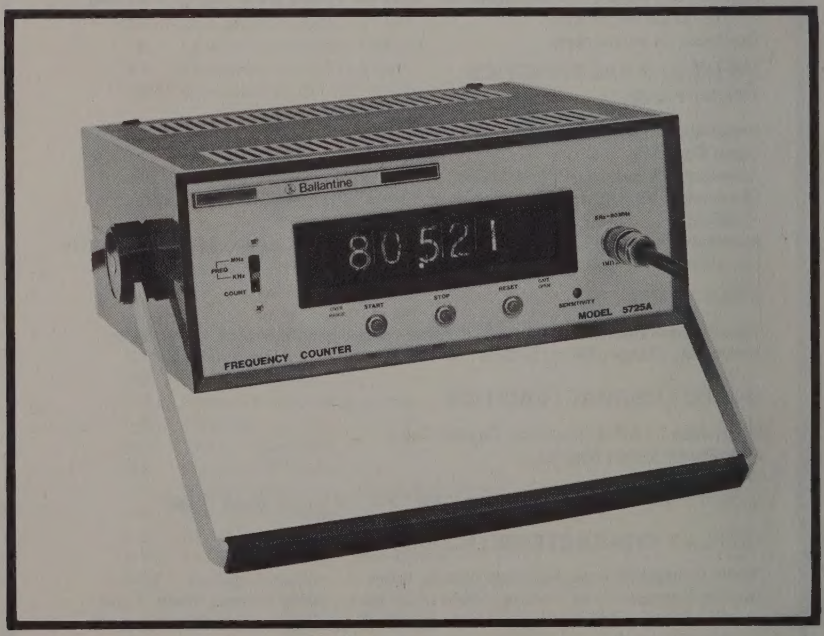



*Figure 1-1. 5725A Frequency Counter*

# General Information

## 1-1. INTRODUCTION

The 5725A Frequency Counter is a compact light-weight and simple instrument capable of counting and measuring frequencies from 5 Hz to 80 MHz. It consists of 5 decade counting units which either count signal pulses for a manually controlled interval (totalize), or, over a specific gated time interval (frequency). The total count is displayed by numeric readout tubes.

Frequency measurements are referenced to an internal time base. This time base is derived either from an internally generated 1 MHz crystal controlled clock or, an externally provided clock. The front panel FREQ KHz or MHz switch selects the time base related gate to provide two ranges of direct readout – KHz and MHz. The 5725A has three operating modes: FREQUENCY, RATIO and COUNT (Totalize).

**COUNT MODE:** The instrument operates as a simple total events counter. The input to the counting circuits is the signal applied to the front panel input connector. The gate time is controlled manually by the START and STOP pushbuttons.

**FREQUENCY MODE:** The instrument directly measures the average frequency of an input signal. The input to the counting circuits is the signal from the front panel input connector. The gate time is 1 mSec with the FREQ switch set to MHz and 1 second when set to KHz. This provides direct readout in KHz and MHz with 1 Hz and 1 kHz resolution respectively.

**FREQUENCY RATIO MODE:** The instrument measures the frequency ratio of two input signals. The input to the counting circuits is the higher of the two input frequencies (A), which is applied to the front panel input connector. Gate time is provided by the lower frequency input signal (B) applied to the rear panel connector.

A quick confidence CHECK of the instrument can be made by connecting the internal 1 MHz crystal controlled oscillator output provided on the rear panel to the input connector on the front panel. The operation of the 5725A is checked when 1 MHz is displayed on the numeric indicators.

## 1-2. INSTRUMENT AND MANUAL IDENTIFICATION

The serial number of the instrument is located on the rear panel. The three left-most digits identify instrument modifications. If this prefix differs from that listed on the title page of this manual, there are differences between this manual and your instrument.

Technical corrections to the manual are listed on an enclosed MANUAL CHANGES sheet (if any).

Ballantine endeavors to provide only the most accurate and reliable instruments for our customers. Periodically instruments are updated to provide the latest design improvements. We reserve the right to make these changes on any later production runs without assuming any liability for updating other instruments.

## 1-3. OPTIONAL ACCESSORIES

| | |
|---|---|
| Probe Kit, 10X Attenuator, 6 ft. | 10601A |
| Cable, coax, RG58C/U, BNC/BNC, 4 ft. | 12249D |
| Cable, coax, RG58C/U, BNC/Alligator, 4 ft. | 12250D |
| Termination, feedthrough, 50 ohm, BNC/BNC | 12630A |
| Filter, low pass (1 kHz) | 12631A |
| Rack Mounting Kit for 1 or 2 5725A Side/Side | 800-05 |
| Half-Rack Cover for 800-05 | 381000051L |

# Installation

## 2-1. INTRODUCTION

The 5725A is shipped in operating condition and is essentially ready for use when received. This section contains instructions for initial installation and inspection.

## 2-2. RECEIVING INSPECTION

Examine the shipping carton for damage before unpacking the instrument. Carefully remove the instrument from the carton. Check immediately for loose or broken control knobs, bent or broken connectors and damage to any cabinet part. If damage of any nature is found, refer to the warranty instructions.

## 2-3. PACKING

The 5725A is a rugged instrument built to perform in severe environments. If the unit is to be shipped or stored for long periods of time the following packing procedure is recommended:

a) Rotate the carry handle until it faces forward and protects the front panel. Coil the power cord and place the coil into the rear panel. It may be desirable to tie the cord and/or put it into a snug fitting plastic bag.

b) Place the counter into an oversize plastic bag and seal the bag.

c) Place the bagged counter into a heavy duty corrugated cardboard box. The box must contain at least 2 inches of rubberized hair or equivalent cushion on all six sides of the instrument. The counter must fit snugly into the cushion and the cushion must fit into the box to prevent any movement of the instrument in transit.

d) Place the instruction manual into the box. If accessories are also to be packed put them into a separate plastic bag and pack into the cushion leaving at least two inches of cushion between the instrument and the accessories as well as an extra cushion between accessories and the box.

e) Seal the box fully with 2 or 3 inch wide packing tape.

f) Properly label and address outside of box with a typed label or an indelible pen. Mark the box Fragile, Delicate Instrument, Handle with care.

If shipment is to the factory, notify Ballantine in advance and include detailed reasons for return inside box along with your name, firm and full mailing address. Also include your phone number and purchase order number.

Ship prepaid by United Parcel Service or Registered Air Parcel Post to:

**Ballantine Laboratories**
**Post Office Box 97**
**90 Fanny Road**
**Boonton, N.J. 07005 USA**

## 2-4. POWER CONNECTIONS

This instrument is designed to operate from either a 115 vac or 230 vac power source. The primary voltage selection is made by positioning a recessed slide switch on the rear panel. To change the position of the slide switch, insert a small screwdriver in the switch slot and set the switch to the required voltage position. Damage caused by using incorrect primary input voltage voids the instrument warranty.

### WARNING

The instrument is provided with a three-conductor power cord which will ground the case when connected to a three-connector grounding outlet. If a grounding outlet is not available, an adapter must be used which provides a good grounding connection.

## 2-5. COOLING

Cooling air enters the case through holes on the covers. Adequate clearance must be provided on all sides of the instrument to allow heat to be dissipated. Be sure that the instrument position permits adequate air circulation and that nearby equipment does not discharge hot air directly on the instrument.

## 2-6. CLOCK SELECTION

An internal 1 MHz crystal controlled clock is provided. There is also provision for using an external clock for increased stability or to obtain a special time base or to operate the 5725A for RATIO measurements. The clock selection is made by positioning of the rear panel two-position recessed slide switch INT – EXT clock to INT when using the internally provided clock, and to EXT when applying an external clock. Switch to EXT when using this as B input (lower frequency) for RATIO MODE.

The 1 MHz clock output may be used to clock other instruments or as a CHECK signal for the 5725A itself. To check the counter simply apply the 1 MHz clock to the front panel input connector and read 1 MHz on the numeric display.

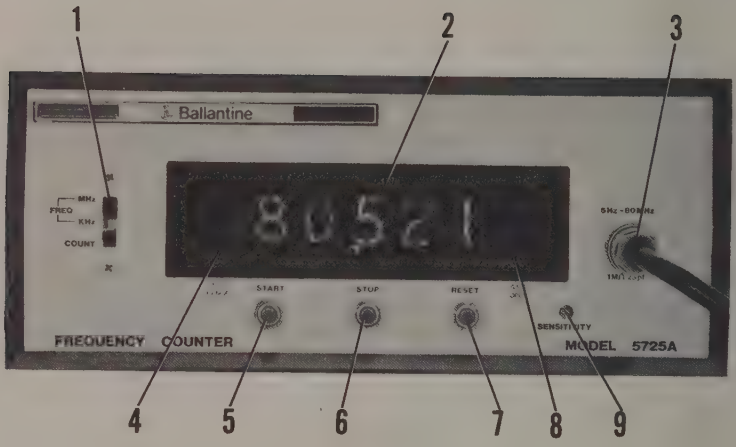



*Figure 3-1. Controls, Connectors and Indicators*

Section 3

# Operation

## 3-1. INTRODUCTION

This section will familiarize the operator with the typical operation procedures of the 5725A. The front and rear panel controls, connectors and indicators are described. Recommended operating procedures demonstrate instrument flexibility.

## 3-2. CONTROLS, CONNECTORS AND INDICATORS

Figure 3-1 shows the instrument's front panel and Table 3-1 describes the functions. These descriptions are not intended to be operating instructions but, briefly, to familiarize the operator with the instrument.

## 3-3. SENSITIVITY CONTROL ADJUSTMENT

The SENSITIVITY control permits adjustment of the input signal to the optimum value for reliable triggering. It is not sufficient to set the control for maximum sensitivity (maximum clockwise position), since the instrument may then be triggered by noise. Conversely, if the trigger level is too low, the instrument may be triggered randomly or not at all. The optimum level is indicated by repeatability of the display. The correct procedure for setting the SENSITIVITY control is as follows:

a) Set the FREQ-COUNT switch to COUNT.
b) Connect the signal to the front panel BNC connector.
c) Press the START pushbutton. The GATE OPEN indicator should light up.
d) Set the SENSITIVITY control for minimum sensitivity (fully counterclockwise). The instrument, in general, will not count with the sensitivity control in CCW position.
e) Rotate the SENSITIVITY control clockwise until the instrument begins to count. Check for repeatability of the display and, if necessary, continue to rotate the control clockwise until repeatability is obtained.
f) Switch to frequency mode and make measurements as required.

**NOTE:** The SENSITIVITY control is a screwdriver adjust because it needs to be used only under limiting conditions of noise and signal amplitude. The FET input circuit has great dynamic range so that the control can usually be set at 2/3 maximum clockwise rotation.

*Table 3-1. Controls, Connectors and Indicators*

| NO. | ITEM | FUNCTION |
|---|---|---|
| 1 | FREQ-COUNT Switch | A three position slide switch used to select the mode of operation. |
| 2 | Display | A five digit numeric readout with positioned decimal point that indicates the magnitude of the quantity measured. The units for the readout are shown on the FREQ – MHz/kHz switch. |
| 3 | 5 Hz-80 MHz Input Connector | A BNC connector that couples the input signal to the instrument. |
| 4 | OVERRANGE Indicator | A light emitting solid-state diode that lights up when the display range of the instrument has been exceeded. |
| 5 | START Pushbutton | Opens the gate in the COUNT (Totalize) mode of operation. |
| 6 | STOP Pushbutton | Closes the gate in the COUNT mode of operation. |
| 7 | RESET Pushbutton | Resets display and internal count to zero in the COUNT mode of operation. |
| 8 | GATE OPEN Indicator | A light emitting diode that lights up when the count gate is open. |
| 9 | SENSITIVITY Control | A screwdriver adjust potentiometer on the front panel which attenuates the input signal to the input amplifier. It determines the minimum signal required to trigger the instrument. Maximum sensitivity is obtained when the control is set fully clockwise. The optimum setting, however, depends upon the amplitude of the input signal. It is normally set 20 degrees off the CW end to assist in rejecting noise. |

*Table 3-1. Controls, Connectors and Indicators (Continued)*

| NO. | ITEM | FUNCTION |
|---|---|---|
| 10 | POWER ON-OFF Switch | A two-position slide switch located on the rear of the instrument which applies ac line power to the instrument when set in the ON position. |
| 11 | INT-EXT CLOCK Switch | A recessed two-position slide switch located on the rear of the instrument. It permits selection of either the internal crystal controlled clock or an external clock. When set to INT, a 1 MHz signal from the internal clock output is available from the BNC connector to drive other counters or instruments. Ratio Mode is accomplished in the EXT position. This switch is normally in the INT position. |
| 12 | INT-EXT CLOCK Connector | A BNC connector on the rear of the instrument which the input:<br>1) of an external clock signal to the instrument<br>2) provides output from the internal crystal controlled 1 MHz clock from the instrument<br>3) provides Ratio "B" (lower frequency) input when INT-EXT CLOCK switch is set to EXT |
| 13 | Clock Frequency Adj. | Capacitor to precisely set internal crystal controlled oscillator to 1 MHz. This is a service adjustment and not intended for regular use. |

## 3-4. OPERATING HINTS

1) Be sure you have proper line voltage and allow a few minutes for warmup.

**NOTE**

Your 5725A may be operated from a car battery or other dc source thru almost any dc to 115 volt ac inverter.

2) Be sure rear panel EXT-INT clock switch is properly set. Normally this switch should be set to INT.

3) Be sure input signal is in the range of amplitude and frequency specified.

4) If random noise or high frequency noise is superimposed on the input signal, use a low pass filter. The Ballantine 12631A 1 kHz low pass filter is recommended when low frequency content signals (such as are found in electro-mechanical systems) are to be measured. Mount the filter at the input of the counter.

5) If input signal contains excessive amplitude modulation or powerline frequency noise a high pass filter to block low frequencies is suggested. The Ballantine 12632A 10 kHz high pass filter is recommended. Mount the filter at the input of the counter.

6) Always use shielded cable to bring the signal to the input of the counter. The Ballantine 12249D 4 ft shielded cable with BNC connectors is recommended.

7) It is advisable to terminate the coax cable at the counter when high frequency signals above the audio range are to be measured. The Ballantine 12630A 50 ohm BNC feed thru termination is recommended. Connect it directly at the input BNC connector of the counter.

8) If signals having amplitudes greater than 50 volts peak are to be counted a 10:1 attenuator probe is recommended. The Ballantine 10601A 6 ft attenuator probe divides the input by ten and will extend the input voltage range of the 5725A to 500 volts peak.

9) Tuned circuits may be affected when connecting the counter. Use of an attenuator probe (Ballantine 12601A) is recommended to minimize loading of the circuit under test. The probe input is 10 megohms stunted by approximately 20 pF.

For critically matched or tuned circuits a loading capacitor and resistor equal to those of the probe may be added to the measurement point after the test probe is removed so that the measurement point always sees the same loading with or without the counter (probe) being connected.

## 3-5. OPERATING PROCEDURES

Paragraphs 3-6 through 3-8 describe operating procedures.

### 3-6. Operation in COUNT mode (Totalize)

1. Set the POWER ON-OFF switch on the rear panel to ON.
2. Connect the signal to the front panel BNC connector. Use a shielded cable to avoid pick up of unwanted signals.
3. Adjust the SENSITIVITY screwdriver control as outlined in par. 3-3.
4. Set FREQ-COUNT switch to COUNT.
5. Press RESET pushbutton which resets the five digit display to 00.000.
6. Start counting by pressing the START pushbutton and stop by pressing the STOP pushbutton.

**NOTE**

If the OVERRANGE indicator is lit, the count indicated is not the total count but is exceeded beyond the 99.999 capacity of the 5 indicator display tubes.

7. Always use a 50 ohm termination directly at the input BNC connector when counting fast rise or high speed signals. The 50 ohm BNC feed thru termination Ballantine 12630A is recommended.
8. When extremely noisy signals are to be counted use a suitable low pass filter in series with the input. The Ballantine 12631A low pass (1 kHz) is recommended when counting in noisy environments or when signal originates from mechanical contacts. A high pass filter, the Ballantine 12632A is also available to attenuate power line hum and audio frequency components. Connect filters at the input BNC connector and, if necessary, terminate the cable with the 12630A termination which then plugs into the filter.

## 3-7. Operation in FREQ mode

1. Set the POWER ON-OFF switch on the rear panel to ON.

2. Connect the signal to be measured (5 Hz to 80 MHz) to the front panel BNC connector. Always use a shielded cable and when measuring frequencies above the audio range use a 50 ohm termination at the input of the counter. The Ballantine 12630A 50 ohm BNC feed thru termination is recommended.

3. Adjust the SENSITIVITY control as outlined in par. 3-3.

4. Set FREQ-COUNT switch to FREQ MHz or kHz as required.

5. The display indicates the frequency of the input signal.

### NOTE

If the OVERRANGE indicator is lit, the count indicated is not the total count but exceeds the 99.99 capacity of the 5 indicator display tubes. Simply switch to MHz if in kHz mode to get highest count display. If higher resolution to 1 Hz is required switch to kHz and the overrange light will serve to indicate that the frequency is higher than that indicated by the display tubes.

6. When measuring low frequencies or very noisy signals a low pass filter is recommended to avoid erratic counting of noise spikes superimposed on the signal. A low pass filter (1 kHz) such as the Ballantine 12631A is recommended. Connect the filter at the input of the counter. If a 50 ohm 12630A termination is used connect it between the filter and the input cable.

## 3-8. Operation in RATIO mode

1. Set the POWER ON-OFF switch on the rear panel to ON.

2. Connect higher frequency input A (5 Hz to 80 MHz) to the front panel BNC connector thru a shielded cable. A 50 ohm termination such as the Ballantine 12630A is recommended when signals above the audio range are to be measured.

3. Connect lower frequency input B (DC to 5 MHz) to the rear panel BNC connector thru a shielded cable. A 50 ohm termination is recommended. Either the 12631 or 12632A filters may be used with slightly changed response characteristics. Mount the termination between filter and input cable. DO NOT EXCEED 5 V peak input for control of input A.

4. Slide the INT-EXT CLOCK slide switch to EXT.

5. Adjust the level SENSITIVITY control as outlined in par. 3-3.

6. Set FREQ-COUNT switch to FREQ MHz or kHz.

7. The display reads A/B with the FREQ switch set to MHz and A/B x 1000 when set to kHz.

### NOTE

If the OVERRANGE indicator is lit, the count indicated is not the total count since the 99.999 capacity of the 5 display tubes is exceeded.

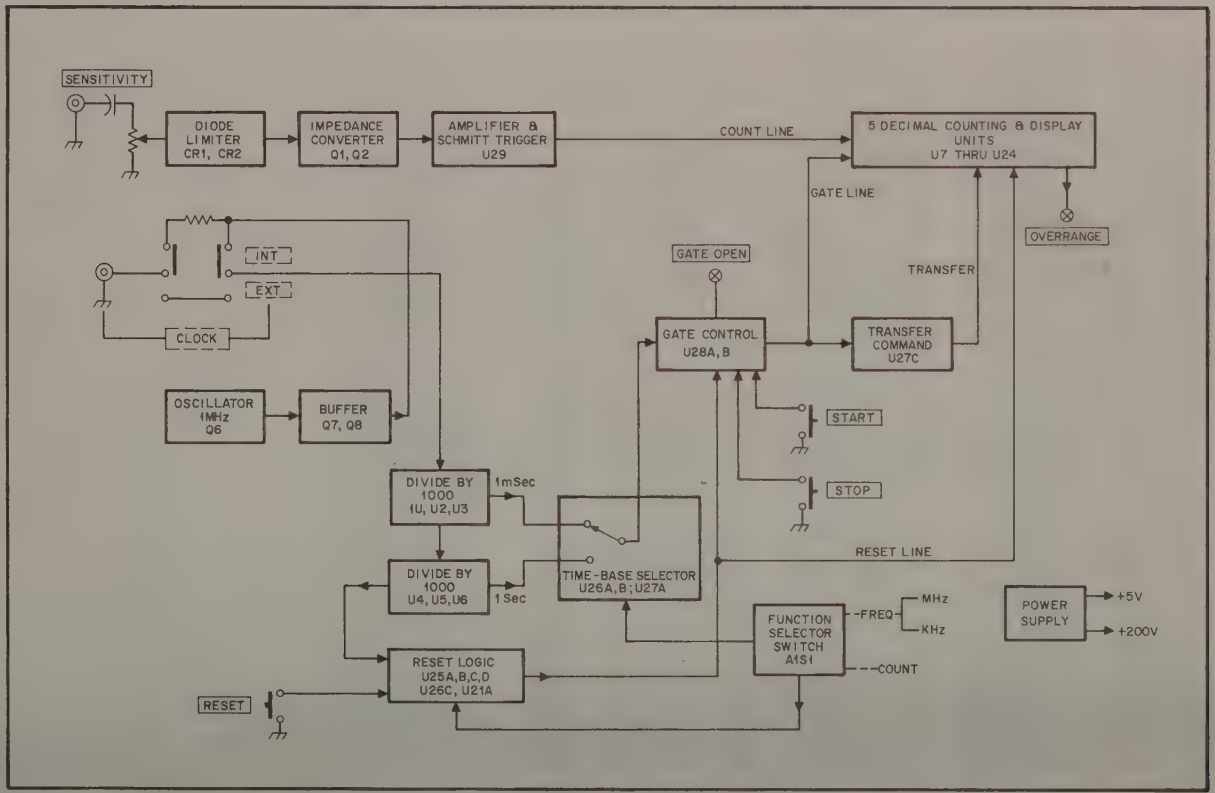



*Figure 4-1. Block Diagram*

# Principles of Operation

## 4-1. INTRODUCTION

This section of the manual contains a description of the circuitry used in the 5725A. Figure 4-1 is a detailed block diagram of the instrument. Basically, the diagram can be broken down into five functional areas. These are:

the input circuit; time-base circuit; control circuit; counting circuits; power supply.

A complete schematic is given at the rear of this manual. Refer to this diagram throughout the following circuit description.

## 4-2. ASSEMBLY DESIGNATIONS

Table 4-1 lists the designations of the assemblies used in this instrument.

*Table 4-1. Assembly Identification*

| ASSY | NAME |
|---|---|
| A1 | Front Panel Assy |
| A2 | Rear Panel Assy |
| A3 | Main P.W. Board Assy |

## 4-3. FRONT PANEL INPUT CIRCUIT OPERATION

The input signals are routed through A1J1, coupling capacitor A3C1 and series resistor A3R1 to the SENSITIVITY control A3R2. This control provides the means for varying the amount of attenuation. A3CR1 and A3CR2 form a bipolar limiter that protects the FET A3Q1 from overload. A3Q2 is an emitter follower which drives the amplifier and Schmitt trigger A3U29.

The output of A3U29 drives the differential amplifier A3Q3 and A3Q4. An emitter follower A3Q5 is used to increase the driving capability of the input circuit.

## 4-4. TIME-BASE CIRCUIT OPERATION

The 1 MHz oscillator consists of transistor A3Q6 with its associated circuitry. A3Q6 operates as a positive feedback amplifier. It forms a very stable crystal-controlled oscillator which can be adjusted to exactly 1 MHz by means of trimmer capacitor A3C17 accessible from the side of the enclosure. The oscillator output is buffered by transistors A3Q7 and A3Q8, which decouple and buffer the oscillator and prevent frequency variations due to loading. The buffered output is applied to the time-base dividers via the EXT-INT CLOCK two-position slide-switch A2S1, mounted on the rear panel.

A3U1, A3U2 and A3U3, connected in series, form a divider of 1000. The output of A3U1 has an exact period of 1 millisecond.

This 1 ms signal is further divided by A3U4, A3U5 and A3U6 to provide a gating waveform with an exact period of 1 second.

The 1 millisecond signal is used as the time-base when the FREQ-COUNT switch on the front panel is in the MHz position and the 1 second signal, when in the kHz position. This provides 1 kHz and 1 Hz resolution respectively in the least significant 5th digit of the display.

## 4-5. CONTROL CIRCUIT OPERATION

The control circuit determines the start and stop functions for the count being taken. It also controls the routing of the input signal pulses and the sequence of operations. The gate control signal is provided by the Gate Control flip-flop A3U28A, pin 11.

In the COUNT mode, the gate is enabled by means of the start pushbutton. A ground potential to the direct-set input (pin 7) of A3U28A, sets the flip-flop. The high at pin 11 acts as an enabling signal of the counter's gate. To stop the counter a ground potential is provided, via diode A3CR4, by the STOP push-button. To reset the counter, ground potential is provided by the RESET switch, and together with the inverter A3U21A resets all counting and control circuits.

In the FREQUENCY MHz mode, the 1 msec signal to the Gate Control flip-flop is routed via A3U26A, A3U27A to pin 6 of A3U28A. In the kHz mode, the 1 sec signal is routed via A3U26B and A3U27A. In the MHz mode, the recycling rate is 5 readings per second. The GATE OPEN indicator light is "stretched" to 100 msec by logic circuitry for easier visibility. After the Gate Control flip-flop is "closed", the Transfer pulse generated at the output of A3U27C will set the decade A3U6 to "g". The "A" output of A3U6 is inverted by A3U25B and applied via A3U25C and D to pin 2 of A3U26. The idealized waveforms are given in figure 4-2.

The RATIO mode is similiar to the FREQ mode, where the 1 MHz oscillator is replaced by an external signal coupled via A2J1 and A2S1 to the divider chain. The signal "B" into the divider chain must always produce fewer counts than signal "A" fed into the front panel signal input BNC Connector. When the FREQ-COUNT switch is in the kHz position "B" input is divided by one thousand and when in the MHz position B is read directly.

i.e. A/B x one thousand (kHz position)
A/B (MHz position)

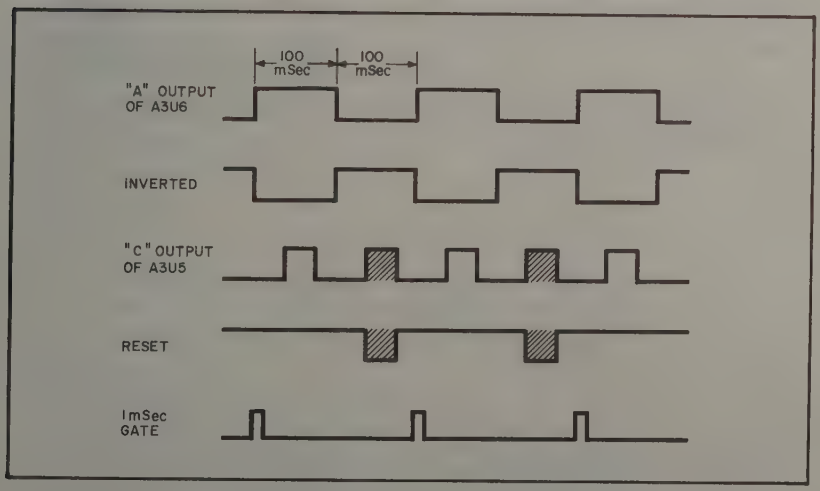



*Figure 4-2. Idealized Waveforms of Gate and Reset Timing*

## 4-6. COUNTING CIRCUITS OPERATION

The counting circuits consist of five decade counting units and a circuit for lighting OVERRANGE indicator. Each unit consists of a decade counter, a memory, a decoder and a display tube.

The $10^0$ decimal counter comprises flip-flops A3U23 and A3U24. It counts the signal on the Count line and when it reaches a count of 10, it produces a carry pulse which is counted by the $10^1$ decimal counter. The $10^1$ counter drives the $10^2$ etc in a similar manner.

The BCD outputs of the counters are stored by the memory circuits. With a logic "0" at the transfer terminals of the memories (pins 4 and 13), the previous display is latched. When a logic "1" appears, provided by the Nand gate A3U27C, the BCD output of the counters is transfered to the decoders.

The carry output of the $10^4$ decade indicates that the maximum capability of the instrument has been exceeded. It operates the RS flip-flop A3U21C and A3U21D. Upon receiving a transfer command, the gates A3U17B, D transfer the overrange signal to the memory, RS flip-flop A3U17A, C which operates the OVERRANGE indicator.

## 4-7. POWER SUPPLY

The power supply provides +200 V and +5 VDC. The instrument may be operated from a 115 or 230 vac supply. The +200 V output is unregulated and is the supply voltage for the display tubes. The +5 volt output is stabilized by means of the zener diode A3CR70 and buffered by emitter followers A3Q9 and A3Q10.

Section 5

# Maintenance and Calibration

## 5-1. INTRODUCTION

This section provides maintenance, calibration and service information for the 5725A. Included are a table of recommended test equipment, input circuit adjustment, oscillator frequency adjustment and an in-cabinet performance check which may be used to verify proper operation of the counter.

## 5-2. TEST EQUIPMENT

Recommended test equipment for troubleshooting, alignment and performance checking is listed in Table 5-1. Test instruments other than those listed may be used if their specifications equal or exceed the required characteristics.

## 5-3. INSTRUMENT COVER REMOVAL

To remove the top or bottom cover, remove the four screws on the bottom of the instrument. Carefully remove top enclosure cover from the instrument To replace cover, reverse procedure.

**WARNING**

115/230 vac and dc supply voltages are exposed when either cover is removed. Disconnect the power cord from the power source before removing the covers.

## 5-4. CLEANING

The 5725A should be cleaned as often as operating conditions require. Accumulation of dirt in the instrument can cause overheating and component breakdown. Dirt on components acts as an insulating blanket and prevents efficient head dissipation.

*Table 5-1. Recommended Test Equipment*

| ITEM | REQUIREMENT | INSTRUMENT |
|---|---|---|
| 1 | 50 kHz to 100 MHz, 5 mV to 5 V constant amplitude sinewave generator | Tektronix Type 191 Signal Generator |
| 2 | 10 Hz to 10 MHz sinewave generator | HP Model 651B |
| 3 | Oscilloscope 15 MHz dual trace 5 mV | Ballantine 1066B |
| 4 | 1 MHz frequency standard traceable to NBS | HP Model 105 A6B |
| 5 | Pulse Generator, 10 Hz to 50 MHz | EH Model G710 |
| 6 | Calibrator (Time and Amplitude) | Ballantine 6125A |
| 7 | Probe, Attenuator 10:1 6 ft | Ballantine 10601A |
| 8 | Decade Resistance Box | General Radio 1434-B |
| 9 | Termination 50 ohms feed-thru BNC | Ballantine 12630A |
| 10 | Insulated Adjustment tool | JFD 5284 |
| 11 | AC TRUE RMS Voltmeter 2 Hz to 20 MHz | Ballantine 323L |
| 12 | Line Voltage Variac | GR W5MT3AW |

Thoroughly clean both the inside and outside of the instrument. Remove dust from inaccessible areas with low pressure compressed air or vacuum cleaner. Use alcohol applied with a cleaning brush to remove accumulations of dirt or grease from connector contacts and component terminals. Clean the exterior of the instrument and the front panel with a mild detergent mixed with water, applying the solution with a soft, lint-free colth.

## 5-5. VISUAL INSPECTION

The 5725A should be inspected occasionally for such defects as broken connections, loose, broken or frayed wiring, dirty or pitted switch and connector contacts and cracked or broken printed circuit boards. Often, before a total or partial failure occurs, a deteriorating component can be located due to obvious discoloration, cracking or warping. Care must be exercised when heat-damaged parts are located. Overheating is usually only a sympton of trouble. For this reason, it is essential to determine the actual cause of overheating before the heat-damaged part is replaced, otherwise, the damage may be repeated.

## 5-6. REPAIR AND REPLACEMENT

Repair and replacement of electrical and mechanical parts must be accomplished with care and caution. Printed circuit component boards can become warped, cracked or burnt from excessive heat or mechanical stress. The following repair techniques are suggested to avoid inadvertant destruction or degradation of parts and assemblies.

Use ordinary 60/40 solder and a 35 to 40 watt pencil type soldering iron on the circuit board. The tip of the iron should be clean and properly tinned for best heat transfer to the solder joint. A higher wattage soldering iron may separate the circuit from the base material. Keep the soldering iron in contact with the BW board for a minimum time to avoid damage to the components or printed conductors.

To desolder components use a commercial "solder sipper", or better, solder-removing SODER-WICK, size 3, manufactured by SOLDER REMOVAL CO., Covina, California.

Always replace a component with its exact duplicate as specified in the parts list.

## 5-7. FRONT PANEL INPUT CIRCUIT ADJUSTMENT

The amplifier and Schmitt trigger A3U29 is factory adjusted for optimum performance. The symmetry of the hysteresis of the Schmitt trigger is established by A3R7 or A3R8. Thus, whenever A3U29 is replaced, the value of A3R7 or A3R8 must be checked (and changed, if necessary) to ensure the correct symmetry. The procedure is as follows:

1) Connect the constant amplitude signal generator (see Table 5-1) to the front panel input connector. Use a 50 ohm BNC feedthru termination at the input of the counter.

2) Set the generator frequency to 50 kHz and the output amplitude to 150 mV p-p.

3) Set the SENSITIVITY control maximum clockwise (maximum sensitivity). Apply power to the counter and allow at least 1/2 hour warmup time.

4) Connect the oscilloscope to pin 14 of A3U29. Use dc coupling for the input and a 10:1 compensated attenuator probe to minimize loading.

5) Connect a decade resistance box in place of A3R7 or A3R8.

6) Adjust the decade resistance box for symmetry of the output.

7) Select a 1/4 watt, 5% resistor with a value as close to that of the decade resistance box as possible and substitute it for A3R7 or A3R8.

8) Check for proper triggering at 80 MHz.

## 5-8. OSCILLATOR CALIBRATION

The calibration of the 5725A is simple and consists only of setting trimming capacitor A3C17 accessible through the left side of the instrument. Care must be taken to ensure that the instrument is calibrated at its normal operating temperature. Failure to do this will result in counter accuracy that is out of specification. The calibration procedure is as follows:

1) Energize the instrument and allow it to warm-up for 72 hours.

### NOTE

The 72-hour warmup must be allowed in order to achieve the specified stability of the quartz-crystal.

2) Operate the oscilloscope in the x-y mode and feed the x input from the 1 MHz standard reference oscillator (see Table 5-1). Be sure it is traceable to NBS, or a primary standard.

3) Observe the 1 MHz signal from the CLOCK output BNC (CLOCK INT-EXT Switch set to INT) on the rear panel of the 5725A on the vertical channel of the oscilloscope.

4) Adjust the oscillator trimming capacitor with a plastic screwdriver until lissajous pattern on the oscilloscope stops drifting and is single valued.

## 5-9. TROUBLESHOOTING BY SELF-CHECK

When malfunction is suspected, disconnect all equipment from counter and perform self-check procedure as given below. If counter does not self-check properly, refer to Section IV, Principles of Operation, for information on the operation of the circuits. If the counter self-checks properly, check that all inputs to counter are within the limits of specifications. If malfunction still occurs, cause is internal to counter. Make performance checks (par. 5-10) to help determine the source of trouble.

The self-check procedure is as follows:

1) Set the INT-EXT CLOCK Switch to INT. In this position, the internal 1 MHz crystal controlled clock is available from the BNC connector on the rear of the 5725A.

2) Connect the 1 MHz signal from the rear panel to the input connector on the front panel thru a shielded BNC-BNC cable.

3) Adjust the input circuit, as outlined in par. 3-3.

4) Set the FREQ-COUNT Switch to COUNT.

5) Press the RESET pushbutton and check that all digits display "0".

6) Press the START pushbutton and check that the counter totalizes, overflows and that the GATE and OVERRANGE indicators are operative.

7) Press the STOP pushbutton. Check that the GATE light goes out and the display is held.

8) Set the FREQ-COUNT Switch to FREQ MHz. The display should read 01.000 ±1 count.

9) Set the FREQ-COUNT Switch to FREQ kHz. The display should read 00.000 ±1 count and the OVERRANGE light should be on.

## 5-10. IN-CABINET PERFORMANCE CHECK

The following performance check verifies proper operation of all circuits in the 5725A, and should normally be used:

a) as part of an incoming inspection check of instrument specifications.

b) as part of troubleshooting procedure.

c) after any repairs or adjustments, before returning instrument to regular service.

### 5-10-1 COUNT MODE

1) Set the FREQ-COUNT Switch to COUNT

2) Connect sinewave signal of 5 or 10 Hz and amplitude 0.5 volt peak-to-peak to signal input BNC connector. Measure the amplitude with the True RMS voltmeter (175 mV rms)

3) Press the RESET pushbutton.

4) Press the START pushbutton.

5) Vary the frequency up from 10 Hz to 10 MHz, and verify correct counting for each digit separately.

6) Check the OVERRANGE indicator is operated when the counter capacity is exceeded.

7) Press the STOP pushbutton. Check that the count stops and the reading is held.

### 5-10-2 FREQUENCY MODE

1) Set the FREQ-COUNT Switch to FREQ MHz or kHz as per Table 5-2.

2) Set the SENSITIVITY control to maximum sensitivity (fully clockwise)

3) Check the instrument according to Table 5-2. The exact input frequency is not important. Check for stable readings. The signal input BNC cable should be terminated into 50 ohms for higher frequency inputs.

**NOTE**

If line frequency is used to check 60 Hz (or 50 Hz) be sure to exercise care to avoid safety hazards. The use of a low pass filter on the input is also recommended.

### 5-10-3 RATIO MODE

1) Set the INT-EXT CLOCK Switch on the rear panel to EXT.

2) Connect a pulse generator (see Table 5-1) to the EXT CLOCK BNC connector. Adjust amplitude to 4 volt approx. and positive pulse-width of 100 nanosecond. Terminate the pulse generator into 50 ohms at the rear BNC connector of the counter. Set up the signal conditions with the aid of a calibrated oscilloscope.

3) Connect sinewave oscillator to front panel signal input BNC connector. Adjust amplitude to 75 mV rms. Constant amplitude generator 50 kHz and the HP 651 oscillator below 50 kHz. Also check with 6125A calibrator for 20 mV 1 kHz square wave and various Time Pulse Settings.

4) Set SENSITIVITY control to maximum sensitivity (maximum clockwise).

5) Check the instrument according to Table 5-3. The exact input frequencies are not important. Check for stable readings.

## 5-11. VOLTAGE READINGS

The +5 volt true shall measure 4.5 to 5.4 volts DC under all conditions of operation and line Voltage Regulation should be $<\pm 200$ mV over ±10% line voltage change. Ripple shall be at twice line frequency and less than 200 mV p-p in the Reset position of COUNT Mode.

The 200 volt DC unregulated shall measure 180 to 240 volts DC at 115/230 volt input.

*Table 5-2. Frequency Mode Performance Check*

| NO. | INPUT AMPLITUDE mV rms | mV p-p | FREQUENCY | READING | FREQ SWITCH SET TO | OVERRANGE |
|---|---|---|---|---|---|---|
| 1 | 120 | 336 | 80 MHz | 80.000 | MHz | no |
| 2 | 75 | 210 | 40 MHz | 40.000 | MHz | no |
| 3 | 75 | 210 | 10 MHz | 10.000 | MHz | no |
| 4 | 75 | 210 | 1 MHz | 01.000 | MHz | no |
| 5 | 75 | 210 | 100 kHz | 00.000 | kHz | yes |
| 6 | 75 | 210 | 10 kHz | 10.000 | kHz | no |
| 7 | 75 | 210 | 1 kHz | 01.000 | kHz | no |
| 8 | 75 | 210 | 100 Hz | 00.100 | kHz | no |
| 9 | 75 | 210 | 10 Hz | 00.010 | kHz | no |
| 10 | 75 | 210 | 5 Hz | 00.005 | kHz | no |

*Table 5-3. Ratio Mode Performance Check*

| NO. | FRONT PANEL FREQUENCY | REAR PANEL FREQUENCY | FREQ SWITCH SET TO | READING | OVERRANGE |
|---|---|---|---|---|---|
| 1 | 50 MHz | 5 MHz | MHz | 10.000 | no |
| 2 | 50 MHz | 1 MHz | MHz | 50.000 | no |
| 3 | 50 MHz | 100 kHz | MHz | 00.000 | yes |
| 4 | 50 kHz | 1 kHz | MHz | 50.000 | no |
| 5 | 1 kHz | 1 MHz | kHz | 01.000 | no |
| 6 | 100 Hz | 1 MHz | kHz | 00.100 | no |

# Notes

# Notes

# Parts List

The replacement parts listed are available from the vendors listed or from Ballantine Labs. at the address shown above. Your local Ballantine Field Engineering Representative may also carry a stock of parts and can assist you. If pricing quotations are required for parts and or repairs your local representative will give the most rapid service or you may contact the Ballantine Factory directly.

When ordering replacement parts always give the following information:

a) Instrument Model number
b) Serial number
c) Ballantine Part number
d) Schematic Symbol number
e) Identification of the part

Ballantine will do its best to improve the instrument and make changes in style of components and replacement parts. Replacement parts may differ in appearance from those found in your instrument but are always equal or superior in performance. Where necessary minor mechanical modifications may be required in the replacement of components.

Parts are generally available locally for most replacements. The parts list calls out the recommended vendors where applicable.

The following parts coding are used:

| | |
|---|---|
| CVC | Capacitor, Variable, Ceramic |
| CCT | Capacitor, Ceramic, Tubular |
| CFP | Capacitor, Fixed, Plastic |
| CCD | Capacitor, Ceramic, Disc |
| CYF | Capacitor, Mylar, Foil |
| CMD | Capacitor, Mica, Dipped |
| CMM | Capacitor, Mica, Molded |
| CEA | Capacitor, Electrolytic, Aluminum |
| CET | Capacitor, Electrolytic, Tantalum |
| CON | Connector |
| DGP | Diode, General Purpose |
| DZG | Diode, Zener, General Purpose |
| DRP | Diode, Bridge, Power |
| FLT | Filter |
| ICP | Integrated Circuit |
| TRQ | Transistor |
| RFF | Resistor, Fixed, Film |
| RFC | Resistor, Fixed, Composition |
| RVC | Resistor, Variable |
| RFW | Resistor, Fixed, Wirewound |
| SWC | Switch |
| LMB | Lamp |
| TRX | Transformer |

## PARTS LIST – FRONT PANEL A1

| REF DESIG | PART NO. | DESCRIPTION | MFR CODE | MFR PART NO. |
|---|---|---|---|---|
| J 1 | 31033790A CON | UG-1094/U,DAGE | 29587 | STATE ELECT.PARTS |
| S 1 | 25100020A SWC | MOM PB SPST NO | 81073 | GRAYHILL 30-1(0130-15) |
| S 2 | 25100020A SWC | MOM PB SPST NO | 81073 | GRAYHILL 30-1(0130-15) |
| S 3 | 25100020A SWC | MOM PB SPST NO | 81073 | GRAYHILL 30-1(0130-15) |
| S 4 | 25100210A SWC | SLIDE MIN DP3T | 78488 | STACKPOLE SS-.0 |

## PARTS LIST – REAR PANEL A2

| REF DESIG | PART NO. | DESCRIPTION | MFR CODE | MFR PART NO. |
|---|---|---|---|---|
| C 1 | 17100000A FLE | POWERLINE FILTER 250V | 50423 | F1740-410581 E.RODERSTEI |
| F | 19028030A FUS | C.3 A SLO-BLO | 75915 | LTF 3AG-0.3 OR EQUIV. |
| FL 1 | 14100000A REG | LINE SURGE SUPPRESSOR | 24446 | GE VP 150A10 |
| J 1 | 31033790A CON | UG-1094/U,DAGE | 29587 | STATE ELECT.PARTS |
| R 1 | 12123000A RFF | 1000.00 250 MW F +- 1% | 16299 | COR TYP NA 55 |
| S 1 | 25077860A SWC | LINE VOLTAGE-SLIDE | 82389 | SWITCHCRAFT #46256LF |
| S 2 | 25077710A | | | |
| S 3 | 25077680A SWC | | | |

## PARTS LIST – MOTHERBOARD A3

| REF DESIG | PART NO. | DESCRIPTION | MFR CODE | MFR PART NO. |
|---|---|---|---|---|
| C 1 | C7C9561CA CCD | 1 NF 1 KV K 10% | 84171 | ARC TYP CCS-102 |
| C 2 | 07095610A CCD | 1 NF 1 KV K 10% | 84171 | ARC TYP CCS-102 |
| C 3 | 07100040A CCD | 4.7PF 500 V DISC | 90201 | RMC TYPE CG |
| C 4 | 07023550A CCD | 22 NF 200 V K 10% | 92741 | GOODALL TYPE 621M |
| C 5 | 07100530A CET | 10.0UF 35.0V M | 56289 | SPRAGUE 1960106X0035A3 |
| C 6 | C7C7816CA CEA | 47 UF 20 V K 10% | 56289 | SPRAGUE 150D476X9020R2 |
| C 7 | 07023550A CCD | 22 NF 200 V K 10% | 92741 | GOODALL TYPE 621M |
| C 8 | 07023550A CCD | 22 NF 200 V K 10% | 92741 | GOODALL TYPE 621M |
| C 9 | 07100530A CET | 10.0UF 35.0V M | 56289 | SPRAGUE 1960106X0035A3 |
| C 10 | 07100860A CCD | 68.0PF 500 V | 90201 | RMC TYPE CG |
| C 11 | C7078160A CEA | 47 UF 20 V K 10% | 56289 | SPRAGUE 150D476X9020R2 |
| C 12 | 07023550A CCD | 22 NF 200 V K 10% | 92741 | GOODALL TYPE 621M |
| C 13 | 07023550A CCD | 22 NF 200 V K 10% | 92741 | GOODALL TYPE 621M |
| C 14 | C7100530A CET | 10.0UF 35.0V M | 56289 | SPRAGUE 1960106X0035A3 |
| C 15 | 07100130A CCC | 100 NF 50 V CHIPCA | 50423 | W050FH104M /TABO |
| C 16 | 07100110A CMD | 24.0PF 100 V J DIPMIC | 84171 | ARCO TYPE RDM15-240J |
| C 17 | C7100100A CVC | 7-25PF 300 V TRIMMER | 72982 | ERIE 538-006-B7-25 PCMON |
| C 18 | C7102530A CMD | 390 PF 500 V J 5% | 84171 | ARC TYP DM-15-391J |
| C 19 | C7022150A CMM | 250 PF 500 V K 10% | 84171 | ARCO TYPE CM20-251 |
| C 20 | C7100530A CET | 10.0UF 35.0V M | 56289 | SPRAGUE 1960106X0035A3 |
| C 21 | 07023550A CCD | 22 NF 200 V K 10% | 92741 | GOODALL TYPE 621M |
| C 22 | 07000050A | | | |
| C 23 | 07095610A CCD | 1 NF 1 KV K 10% | 84171 | ARC TYP CCS-102 |
| C 24 | 07095610A CCD | 1 NF 1 KV K 10% | 84171 | ARC TYP CCS-102 |
| C 25 | C7C93540A CEA | 16 UF K | 73445 | AMP TYP C426AR/D16 |
| C 26 | C7100940A CEA | 2.2NF 16 V | | STETNER TRUSH ERO EGK |
| C 27 | 07100940A CEA | 2.2NF 16 V | | STETNER TRUSH ERO EGK |
| C 28 | C7100530A CEA | 100.0UF 16 V UPPC MN | | STETNER TRUCH ERO EK4701 |
| C 29 | 07100530A CET | 10.0UF 35.0V M | 56289 | SPRAGUE 1960106X0035A3 |
| C 30 | 07023550A CCD | 22 NF 200 V K 10% | 92741 | GOODALL TYPE 621M |
| C 31 | 07023550A CCD | 22 NF 200 V K 10% | 92741 | GOODALL TYPE 621M |
| C 32 | 07023550A CCD | 22 NF 200 V K 10% | 92741 | GOODALL TYPE 621M |
| C 33 | 07023550A CCD | 22 NF 200 V K 10% | 92741 | GOODALL TYPE 621M |
| C 35 | 07023550A CCD | 22 NF 200 V K 10% | 92741 | GOODALL TYPE 621M |
| C 36 | 07023550A CCD | 22 NF 200 V K 10% | 92741 | GOODALL TYPE 621M |
| C 37 | 07023550A CCD | 22 NF 200 V K 10% | 92741 | GOODALL TYPE 621M |
| C 38 | 07100530A CET | 10.0UF 35.0V M | 56289 | SPRAGUE 1960106X0035A3 |
| C 39 | 07100530A CET | 10.0UF 35.0V M | 56289 | SPRAGUE 1960106X0035A3 |
| C 40 | C7100530A CET | 10.0UF 35.0V M | 56289 | SPRAGUE 1960106X0035A3 |
| C 41 | 07100530A CET | 10.0UF 35.0V M | 56289 | SPRAGUE 1960106X0035A3 |

## PARTS LIST – MOTHERBOARD A3 (Continued)

| REF DESIG | | PART NO. | DESCRIPTION | MFR CODE | MFR PART NO. |
|---|---|---|---|---|---|
| CR | 1 | C51CC260A | DGP 1N4151 SILICON | 24446 | GE |
| CR | 2 | C51CC260A | DGP 1N4151 SILICON | 24446 | GE |
| CR | 3 | C5100260A | DGP 1N4151 SILICON | 24446 | GE |
| CR | 4 | C51CC250A | DGP 1N281 GERMANIUM | 15238 | ITT |
| CR | 5 | C51CC250A | DGP 1N281 GERMANIUM | 15238 | ITT |
| CR | 6 | C51CC250A | DGP 1N281 GERMANIUM | 15238 | ITT |
| CR | 7 | C510C250A | DGP 1N281 GERMANIUM | 15238 | ITT |
| CR | 8 | C510C250A | DGP 1N281 GERMANIUM | 15238 | ITT |
| CR | 9 | C5094810A | DGP IN4005 | 04713 | MOTOROLA |
| CR | 10 | C51CCC00A | DZG 6.2V +- 5% 400MW 1N753B | 12954 | DICKSON ELECTRONICS |
| CR | 11 | C5C946SCA | DGP MDA 920A-2 | 04713 | MOTOROLA |
| CR | 12 | C51CC25CA | DGP 1N281 GERMANIUM | 15238 | ITT |
| DS | 1 | 211CC000A | T8E NIXIE NUMERIC | 83594 | BURROUGHS |
| DS | 2 | 211CC000A | T8E NIXIE NUMERIC | 83594 | BURROUGHS |
| DS | 3 | 211CC000A | T8E NIXIE NUMERIC | 83594 | BURROUGHS |
| DS | 4 | 211CCCCCA | T8E NIXIE NUMERIC | 83594 | BURROUGHS |
| DS | 5 | 211CCCCCA | T8E NIXIE NUMERIC | 83594 | BURROUGHS |
| DS | 6 | 161CCCCCA | LMP PAN GALIUM ARSENIDE | 28480 | (HP)-5082-4440 |
| DS | 7 | 161CCCCCA | LMP PAN GALIUM ARSENIDE | 28480 | (HP)-5082-4440 |
| L | 1 | 461CCC3CA | FRB FER BD CERAMAG 24 | 78488 | STACKPOLE 571355 |
| L | 2 | 461CCC3CA | FRB FER BD CERAMAG 24 | 78488 | STACKPOLE 571355 |
| L | 3 | 461CCC3CA | FRB FER BD CERAMAG 24 | 78488 | STACKPOLE 571355 |
| Q | 1 | 1C10C36CA | TRQ 2N5459 FET MPF 105 | 04713 | MOTOROLA |
| Q | 2 | 1CC79340A | TRQ 2N3640 | 07263 | FAIRCHILD |
| Q | 3 | 1CC7934CA | TRQ 2N3640 | 07263 | FAIRCHILD |
| Q | 4 | 10079340A | TRQ 2N3640 | 07263 | FAIRCHILD |
| Q | 5 | 1CC7934CA | TRQ 2N3640 | 07263 | FAIRCHILD |
| Q | 6 | 10100340A | TRQ 2N4124 NPN | 04713 | MOTOROLA |
| Q | 7 | 1C100340A | TRQ 2N4124 NPN | 04713 | MOTOROLA |
| Q | 8 | 1C100330A | TRQ 2N3646 NPN | 04713 | MOTOROLA |
| Q | 9 | 1C10C320A | TRQ 2N1613 NPN | 04713 | MOTOROLA |
| Q | 10 | 1C1CCC4CA | TRQ TRANSISTOR TYPE AJE520 | 04713 | MOTOROLA |
| R | 1 | 12125CCCA | RFF 0100.0K 250 MW F +- 1% | 16299 | COR TYP NA 55 |
| R | 2 | 09100470A | RVC 1.0 M PC CERMET TRMPT | 32997 | BOURNS 3359W 1-105 |
| R | 3 | 1212164CA | RFF 0046.40 25C MW F +- 1% | 16299 | COR TYP NA 55 |
| R | 4 | 12121C00A | RFF CC1C.00 250 MW F +- 1% | 16299 | COR TYP NA 55 |
| R | 5 | 12123320A | RFF 2150.00 25C MW F +- 1% | 16299 | COR TYP NA 55 |
| R | 6 | 12122520A | RFF 0348.00 250 MW F +- 1% | 16299 | COR TYP NA 55 |
| R | 7 | A | | | |
| R | 8 | A | | | |
| R | 9 | 12123C0CA | RFF 1000.00 250 MW F +- 1% | 16299 | COR TYP NA 55 |
| R | 10 | 1212332CA | RFF 2150.00 250 MW F +- 1% | 16299 | COR TYP NA 55 |
| R | 11 | 12122640A | RFF 0464.00 250 MW F +- 1% | 16299 | COR TYP NA 55 |
| R | 12 | 1212264CA | RFF 0464.00 250 MW F +- 1% | 16299 | COR TYP NA 55 |
| R | 13 | 12121C0CA | RFF 0010.00 25C MW F +- 1% | 16299 | COR TYP NA 55 |
| R | 14 | 12123C0CA | RFF 1000.00 250 MW F +- 1% | 16299 | COR TYP NA 55 |
| R | 15 | 1212264CA | RFF 0464.00 25C MW F +- 1% | 16299 | COR TYP NA 55 |
| R | 16 | 12121C0CA | RFF CC1C.00 250 MW F +- 1% | 16299 | COR TYP NA 55 |
| R | 17 | 12121520A | RFF 0034.80 25C MW F +- 1% | 16299 | COR TYP NA 55 |
| R | 18 | 1212232CA | RFF 0215.00 250 MW F +- 1% | 16299 | COR TYP NA 55 |
| R | 19 | 12122080A | RFF 0121.00 25C MW F +- 1% | 16299 | COR TYP NA 55 |
| R | 20 | 1212264CA | RFF 0464.00 250 MW F +- 1% | 16299 | COR TYP NA 55 |
| R | 21 | 1212416CA | RFF 0014.7K 25C MW F +- 1% | 16299 | COR TYP NA 55 |
| R | 22 | 1212416CA | RFF 0014.7K 250 MW F +- 1% | 16299 | COR TYP NA 55 |
| R | 23 | 12122C0CA | RFF 0100.00 250 MW F +- 1% | 16299 | COR TYP NA 55 |
| R | 24 | 12122320A | RFF 0215.00 250 MW F +- 1% | 16299 | COR TYP NA 55 |
| R | 25 | 1212316CA | RFF 1470.00 25C MW F +- 1% | 16299 | COR TYP NA 55 |
| R | 26 | 1212264CA | RFF 0464.00 250 MW F +- 1% | 16299 | COR TYP NA 55 |
| R | 27 | 1212264CA | RFF 0464.00 25C MW F +- 1% | 16299 | COR TYP NA 55 |
| R | 28 | 1212264CA | RFF 0464.00 250 MW F +- 1% | 16299 | COR TYP NA 55 |
| R | 29 | 12122160A | RFF 0147.00 25C MW F +- 1% | 16299 | COR TYP NA 55 |
| R | 30 | 12122160A | RFF 0147.00 250 MW F +- 1% | 16299 | COR TYP NA 55 |
| R | 31 | 1212364CA | RFF 4640.00 250 MW F +- 1% | 16299 | COR TYP NA 55 |
| R | 32 | 12122160A | RFF 0147.00 250 MW F +- 1% | 16299 | COR TYP NA 55 |
| R | 33 | 1212364CA | RFF 4640.00 25C MW F +- 1% | 16299 | COR TYP NA 55 |
| R | 34 | 1212364CA | RFF 4640.00 250 MW F +- 1% | 16299 | COR TYP NA 55 |
| R | 35 | 1212364CA | RFF 4640.00 250 MW F +- 1% | 16299 | COR TYP NA 55 |

## PARTS LIST – MOTHERBOARD A3 (Continued)

| REF DESIG | PART NO. | DESCRIPTION | MFR CODE | MFR PART NO. |
|---|---|---|---|---|
| R 36 | 12122520A | RFF 0348.00 250 MW F +- 1% | 16299 | COR TYP NA 55 |
| R 37 | 12122520A | RFF 0348.00 250 MW F +- 1% | 16299 | COR TYP NA 55 |
| R 38 | 12122520A | RFF 0348.00 250 MW F +- 1% | 16299 | COR TYP NA 55 |
| R 39 | 12123640A | RFF 4640.00 250 MW F +- 1% | 16299 | COR TYP NA 55 |
| R 40 | 12123640A | RFF 4640.00 250 MW F +- 1% | 16299 | COR TYP NA 55 |
| R 41 | 12122640A | RFF 0464.00 250 MW F +- 1% | 16299 | COR TYP NA 55 |
| R 42 | 12124320A | RFF 0021.5K 250 MW F +- 1% | 16299 | COR TYP NA 55 |
| R 43 | 12124320A | RFF 0021.5K 250 MW F +- 1% | 16299 | COR TYP NA 55 |
| R 44 | 12124320A | RFF 0021.5K 250 MW F +- 1% | 16299 | COR TYP NA 55 |
| R 45 | 12124320A | RFF 0021.5K 250 MW F +- 1% | 16299 | COR TYP NA 55 |
| R 46 | 12124320A | RFF 0021.5K 250 MW F +- 1% | 16299 | COR TYP NA 55 |
| R 47 | 12125320A | RFF 0215.0K 250 MW F +- 1% | 16299 | COR TYP NA 55 |
| R 48 | 12122320A | RFF 0215.00 250 MW F +- 1% | 16299 | COR TYP NA 55 |
| R 49 | 12123000A | RFF 1000.00 250 MW F +- 1% | 16299 | COR TYP NA 55 |
| R 50 | 12123640A | RFF 4640.00 250 MW F +- 1% | 16299 | COR TYP NA 55 |
| R 51 | 12123000A | RFF 1000.00 250 MW F +- 1% | 16299 | COR TYP NA 55 |
| R 52 | 12122720A | RFF 0562.00 250 MW F +- 1% | 16299 | COR TYP NA 55 |
| R 53 | 12124000A | RFF 0010.0K 250 MW F +- 1% | 16299 | COR TYP NA 55 |
| T 1 | 2040CC60A | TRX PWR XFORM FOR 5725A | 50423 | TABOR 25000030 |
| U 1 | 2410C030A | TCD SN7490N | 01295 | TEXAS INSTRUMENT |
| U 2 | 2410C030A | TCD SN7490N | 01295 | TEXAS INSTRUMENT |
| U 3 | 2410C030A | TCD SN7490N | 01295 | TEXAS INSTRUMENT |
| U 4 | 2410C030A | TCD SN7490N | 01295 | TEXAS INSTRUMENT |
| U 5 | 2410C030A | TCD SN7490N | 01295 | TEXAS INSTRUMENT |
| U 6 | 2410C030A | TCD SN7490N | 01295 | TEXAS INSTRUMENT |
| U 7 | 2410C013A | ICP 7441 | 18324 | SIGNETICS |
| U 8 | 2410C130A | ICP 7441 | 18324 | SIGNETICS |
| U 9 | 2410C130A | ICP 7441 | 18324 | SIGNETICS |
| U 10 | 2410C130A | ICP 7441 | 18324 | SIGNETICS |
| U 11 | 2410C013A | ICP 7441 | 18324 | SIGNETICS |
| U 12 | 2410C150A | ICP 7475 TTL | 18324 | SIGNETICS |
| U 13 | 2410C150A | ICP 7475 TTL | 18324 | SIGNETICS |
| U 14 | 2410C150A | ICP 7475 TTL | 18324 | SIGNETICS |
| U 14 | 2410C150A | ICP 7475 TTL | 18324 | SIGNETICS |
| U 15 | 2410C150A | ICP 7475 TTL | 18324 | SIGNETICS |
| U 16 | 2410C150A | ICP 7475 TTL | 18324 | SIGNETICS |
| U 17 | 2409407CA | ICP T.I.SN7400N OR | 56289 | SPRAGUE USN7400A |
| U 18 | 2410CC3CA | TCD SN7490N | 01295 | TEXAS INSTRUMENT |
| U 19 | 2410C03CA | TCD SN7490N | 01295 | TEXAS INSTRUMENT |
| U 20 | 2410C030A | TCD SN7490N | 01295 | TEXAS INSTRUMENT |
| U 21 | 2409407CA | ICP T.I.SN74CON OR | 56289 | SPRAGUE USN7400A |
| U 22 | 2410C140A | ICP 8280 TTL DEC.CTR | 18324 | SIGNETICS |
| U 23 | 2410C28CA | ICP 8F228 DUAL JK FLIP FLOP | 18324 | SIGNETICS |
| U 24 | 2410032CA | ICP 745112 DUAL JK SCHOTTKY | 01245 | TEXAS INSTRUMENT |
| U 25 | 2409407CA | ICP T.I.SN74CON OR | 56289 | SPRAGUE USN7400A |
| U 26 | 2410017CA | ICP 7410 TTL TRIP 3-INP | 07263 | FAIRCHILD |
| U 27 | 2409407CA | ICP T.I.SN74CON OR | 56289 | SPRAGUE USN7400A |
| U 28 | 2410C41CA | ICP LIN DUAL DD AMP 10116 | 04713 | MOTOROLA |
| U 29 | 2410C42CA | ICP 7476 TTL | 18324 | SIGNETICS |
| Y 1 | 0440004CA | CRS 1.0MHZ XTAL CAN/5725 | 50423 | TABOR 08001000 ALSO ERC |

Section 7

# Circuit Diagrams

This section contains component location illustrations and schematics. The component location illustrations identify, by reference designation, the location of all components shown on the schematics.

All the components shown on the schematics and component location illustrations are described in the parts list in Section 6. Any replacement parts required should be selected from the parts list.

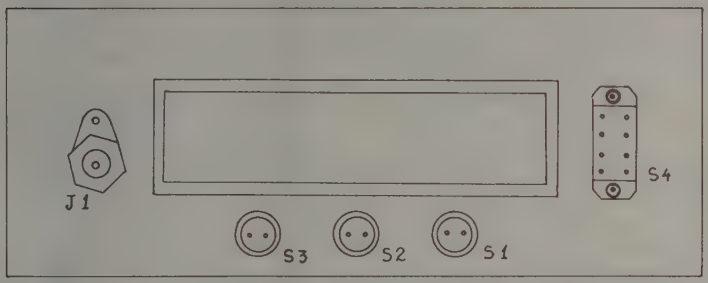



**Figure 7-1. Component Locations, Front Panel A1**

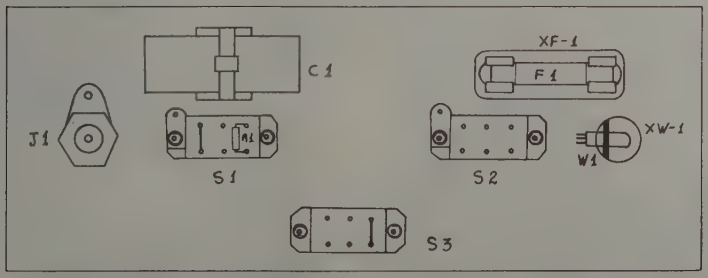



**Figure 7-2. Component Locations, Rear Panel A2**

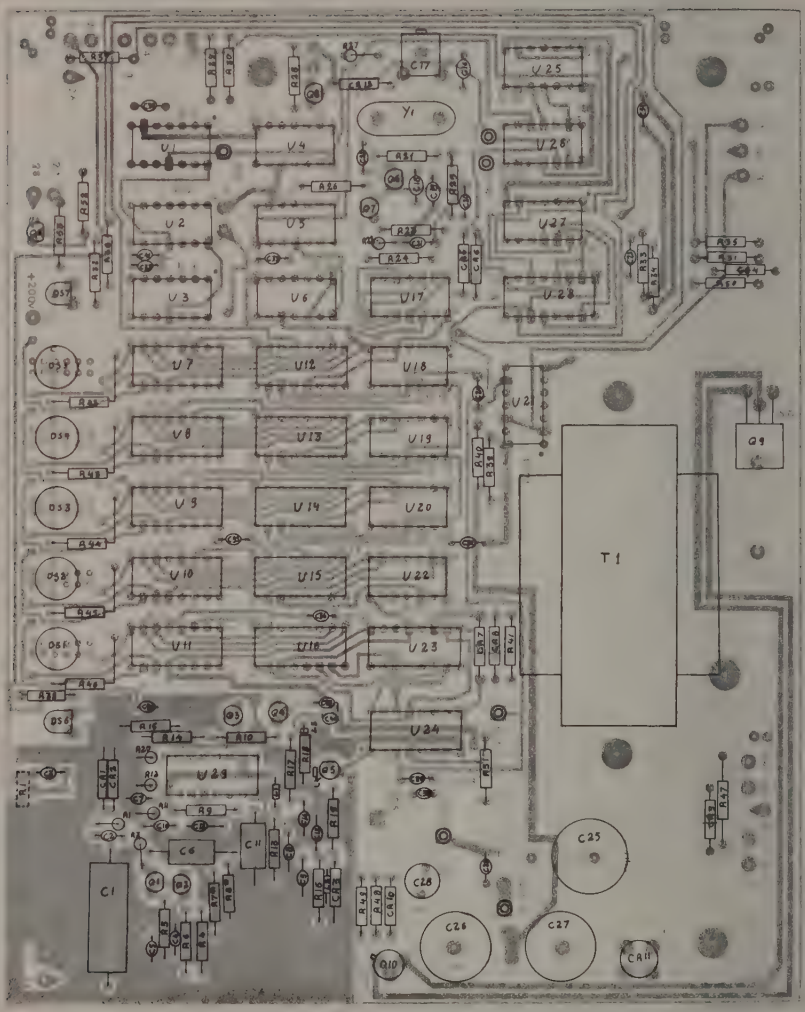
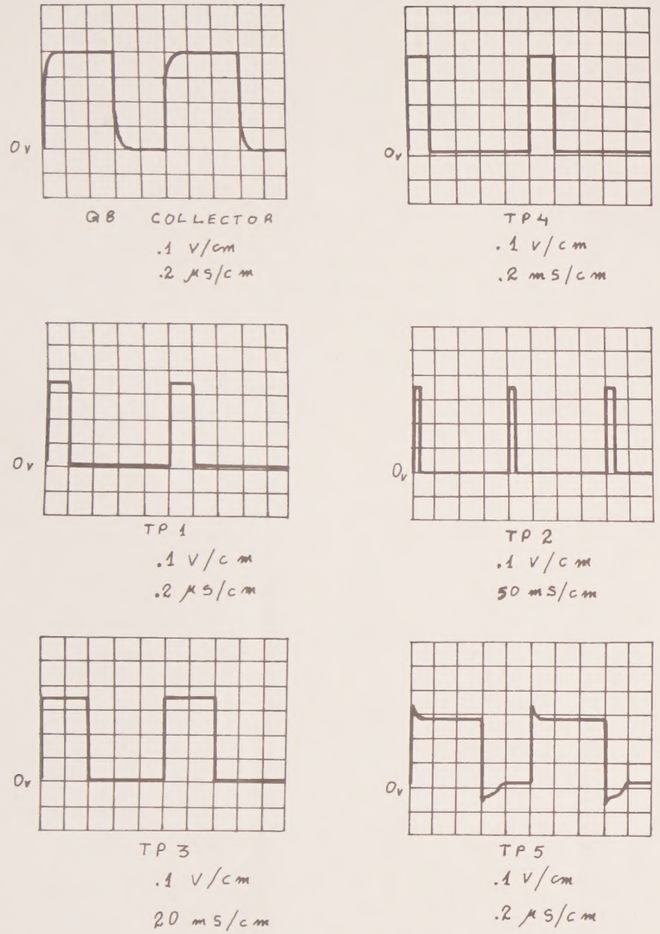



**Figure 7-3. Component Locations, Motherboard A3**




All waveforms dc coupled through 10:1 divider probe.

Counter Controls:
MHz/kHz/Count - - - - MHz
1MHz clock output is connected to input jack.

**Figure 7-4. Test Point Waveforms, Motherboard A3**

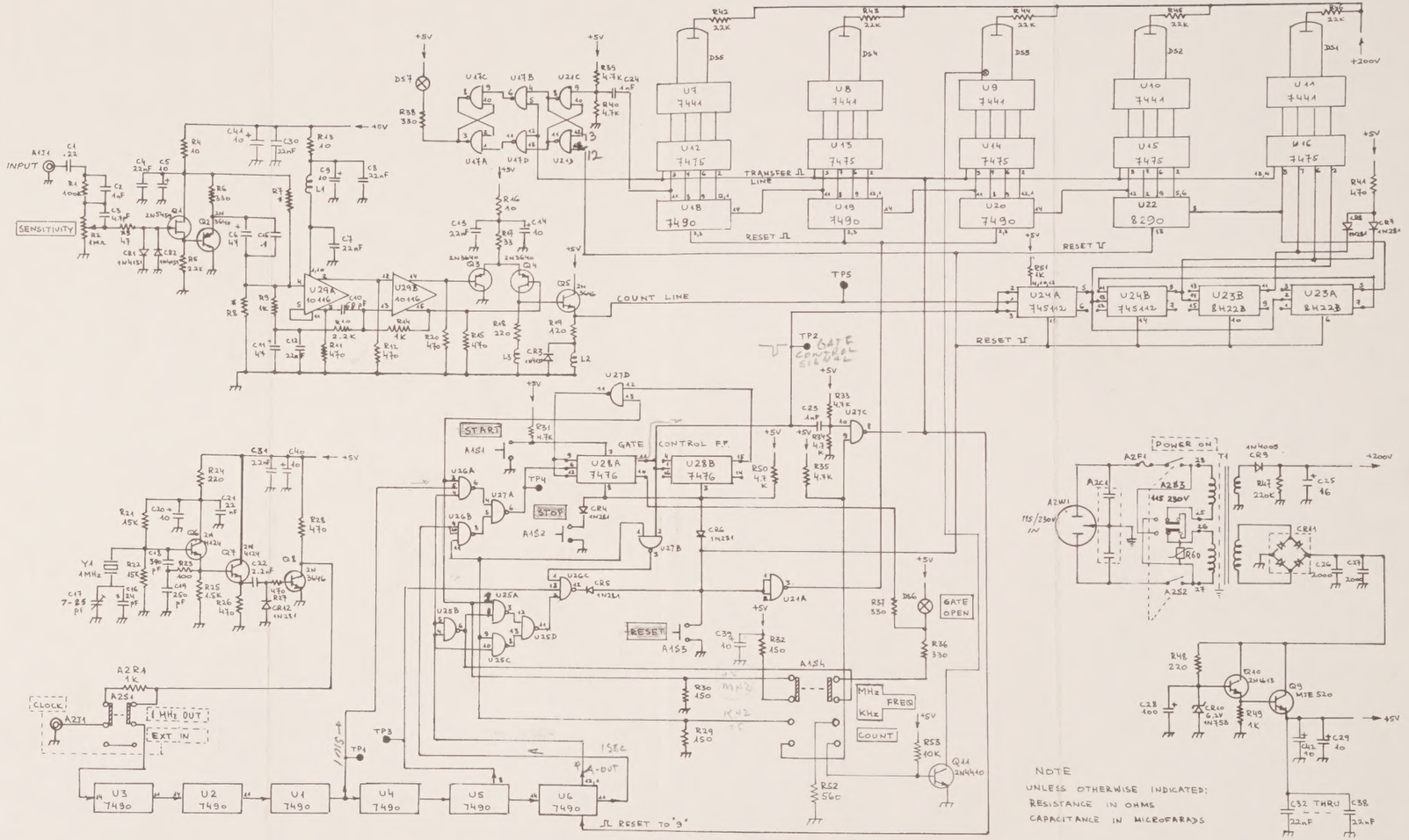



**Figure 7-5. Schematic Diagram**

MP MASTER
MA31975